Differential Hanle effect observed in molecular lines at LJR

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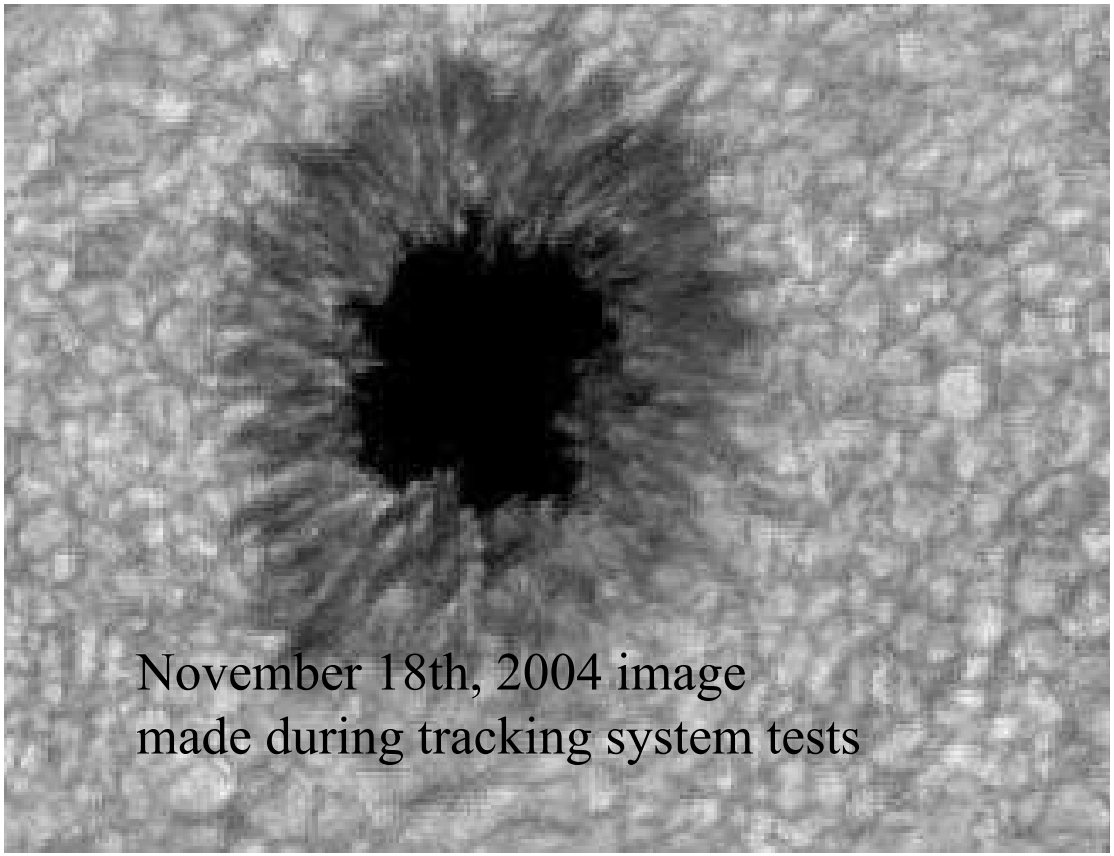
Some of the highlights of this instrument

- Observations at Prime focus:
  High throughput and very low instrumental polarization
- Excellent image quality
- Excellent blue sensitivity
- Management by the users:
  Efficiency, flexibility
- Very low exploitation cost



LJR Instrumentation

- *An Echelle spectrograph built by Zadig Mouradian (LESIA)*
  On spectral domain is observed at a time, and it is very easy and fast to change of spectral domain

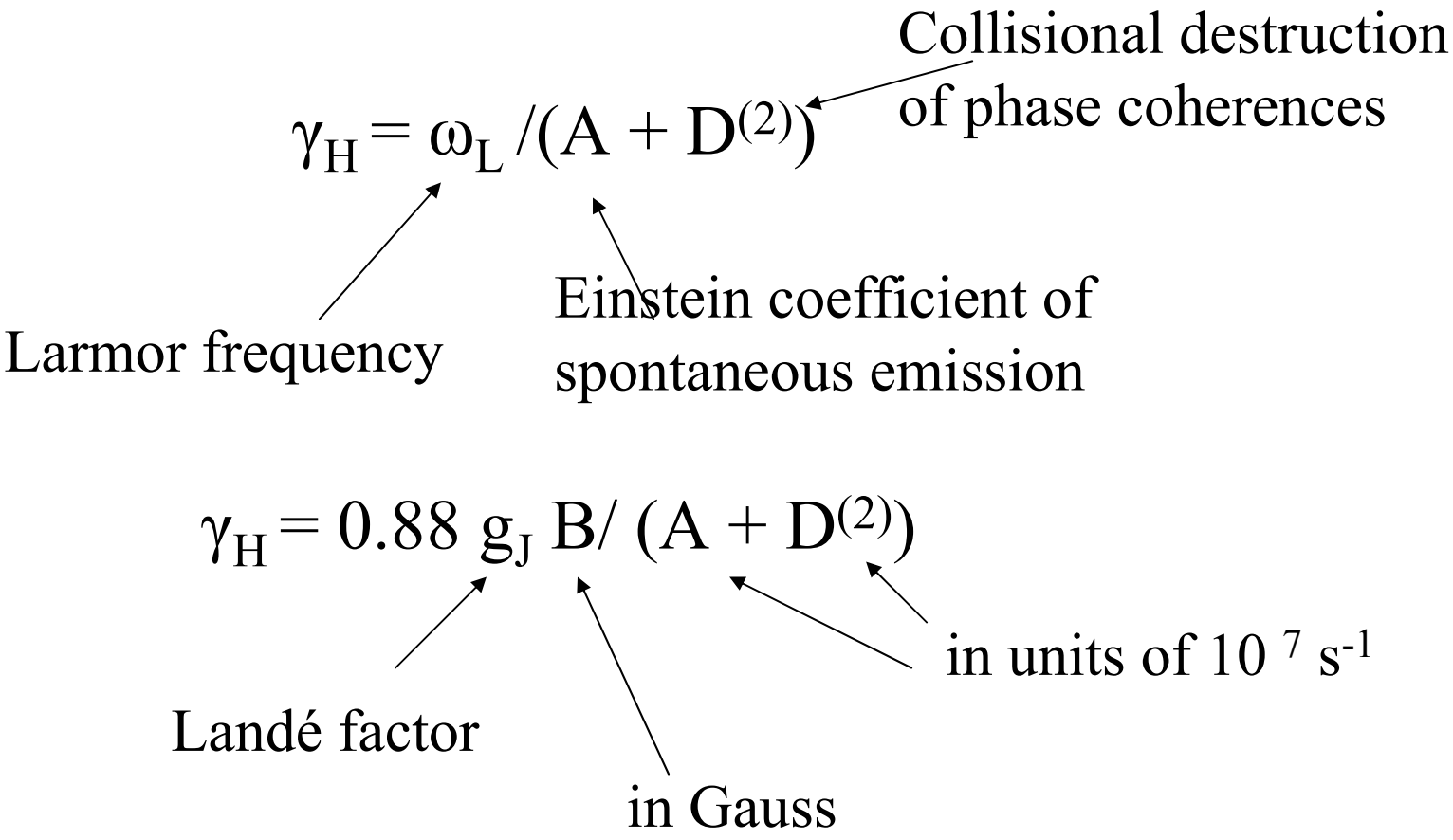
- *A polarimeter developped by Jean-Marie Malherbe (LESIA)*
  The polarization analysis is performed using two nematic liquid cristal retarders followed by a polarimeter
  A beam splitter is under development, it will be installed at the spectrograph entrance (Meir Semel, LESIA)

- *A LaVision CCD 1289x1024 pixels, 25 000 e^- full well (Richard Muller, LATT)*

- *An MSDP mode: Pierre Mein (LESIA)*

- *CALAS: a large field (10x10 arcmin) high resolution (0.14 arcsec/pixel) camera for imagery and LOS magnetometry, developped by Nadège Meunier (LATT)*

Hanle parameters



To deduce B from Hanle depolarization, one needs to know

g_J , A and $D^{(2)}$

The differential Hanle effect

Magnetic fields diagnostics using differential Hanle depolarization of lines forming the same way in the same regions of the atmosphere, but with different Hanle sensitivities (different Lande factors) are much less model sensitive than simple Hanle effect diagnostics. They are also much less sensitive to observations conditions: seeing, limb distance uncertainties, ..

Polarization in weak spectral lines, like molecular lines, can be described using simple models.

Berdyugina, Stenflo and Gandorfer (A&A, 2002, 388, 1062) computed the molecular factors needed for Hanle diagnostics in molecular lines.

Faurobert and Arnaud (A&A, 2003, 412, 555) used differential Hanle effect to determine 20 G fields from near to 516 nm C_2 lines linear polarization (Themis observations).

Berdyugina and Fluri (A&A, 2004, 417, 775) determined the same way 15 G fields from C_2 lines near to 514 nm (using observations from the atlas by Gandorfer).

$D^{(2)}$ can be determined using enough molecular lines.

The observations

The observations presented in this talk were performed between 9:15 and 10:30 UT, on September 17, 2004, 10 arcsec inside the Sun ($\mu = 0.2$), near north and south solar Poles, the spectrograph entrance slit beeing parallel to the limb.

Entrance slit: width 0.6 arcsec, length 2 arcminutes

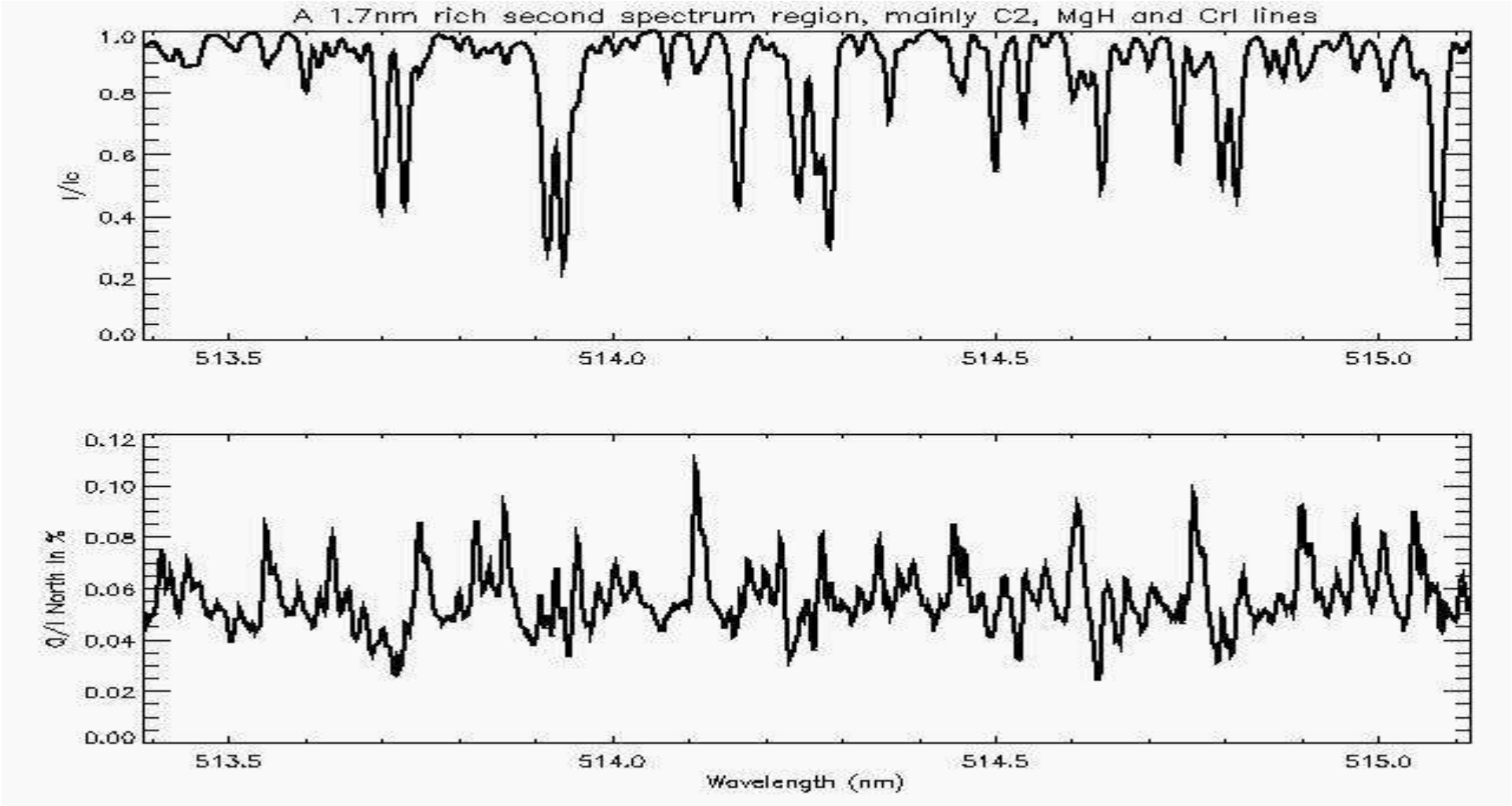
Spatial scale: 0.2 arcsec/pixel Spectral resolution: 1.6 pm/pixel
Spectral coverage: 1.75 nm

A total of 4000 CCD frames were accumulated in 27 mn at south Pole in 250 files of 16 frames, with 100 msec exposure time.

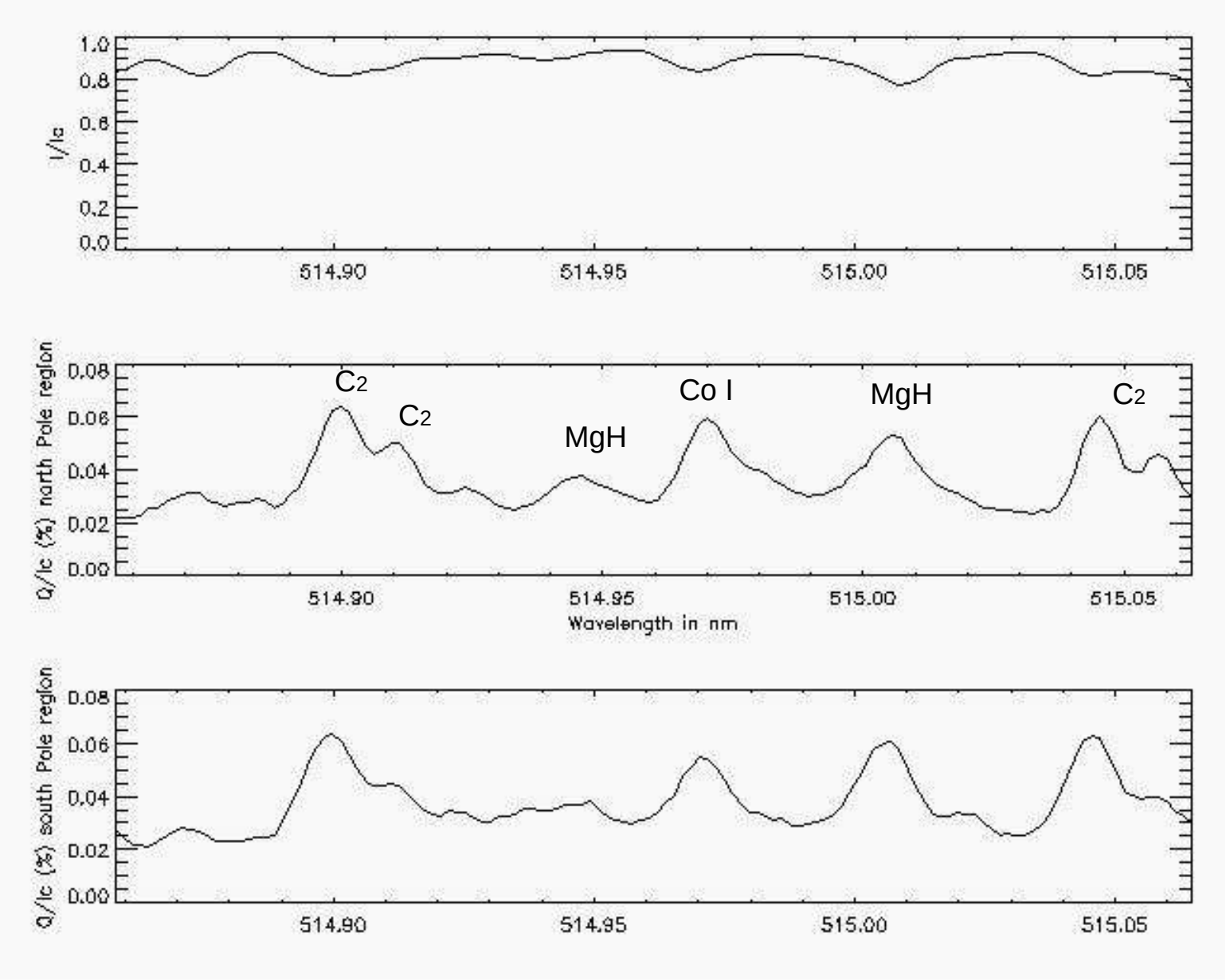
Polarization spectra presented hereafter are averaged along the slit.
This reduces the noise level to $1.10^{-5}\, I_C$.

The full CCD spectral domain

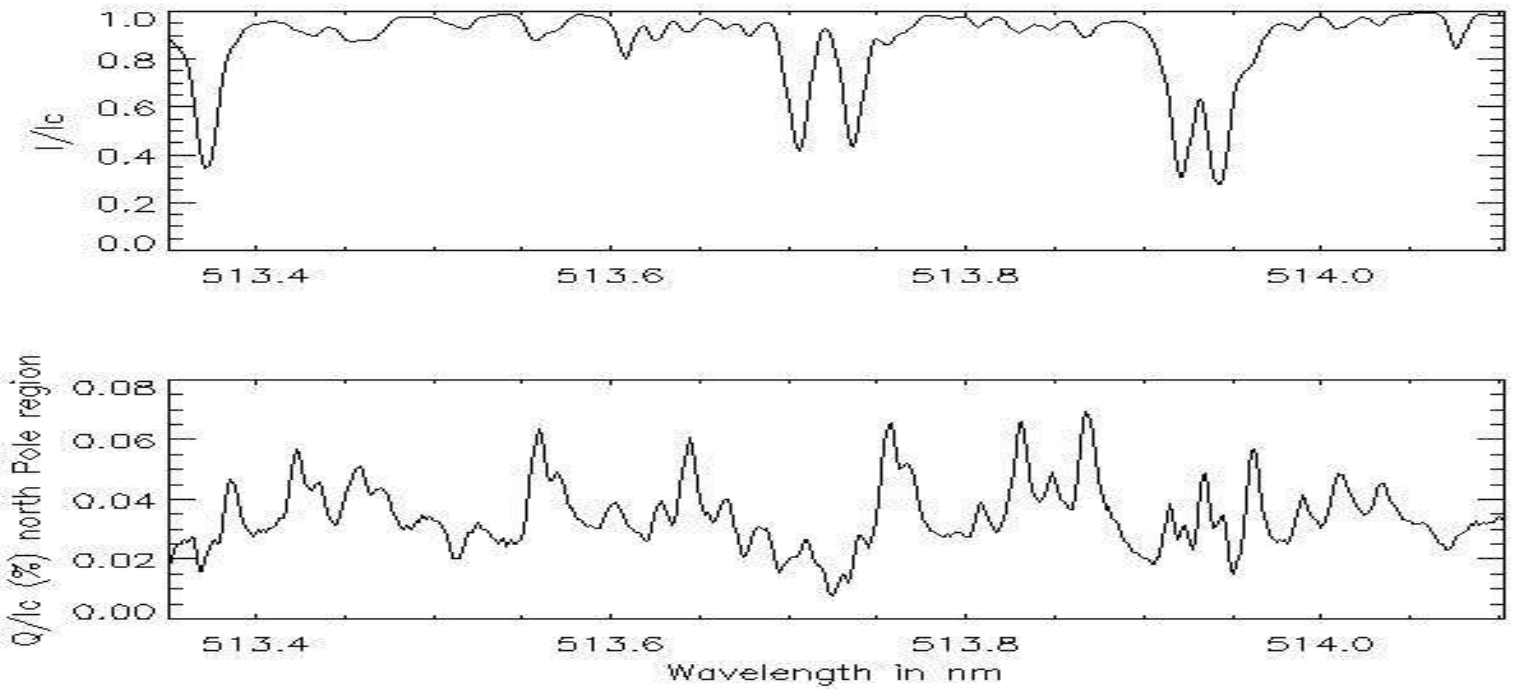
from 513.28 to 515.12 mn

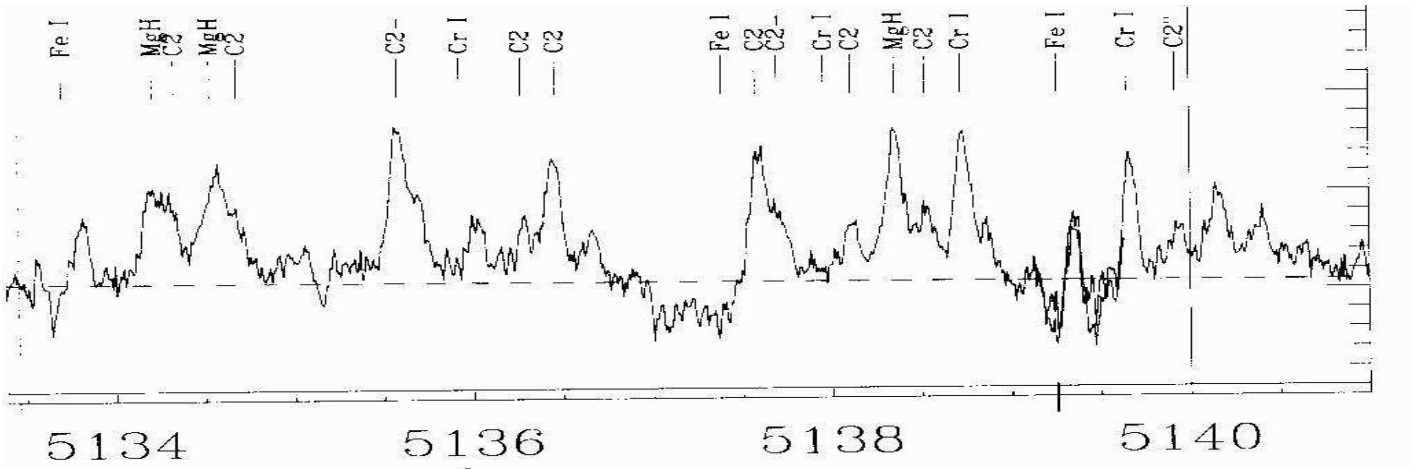


North and south pole regions polarization spectra



LJR ($\eta = 0.2$) and Gandorfer atlas ($\eta = 0.1$) polarization spectra





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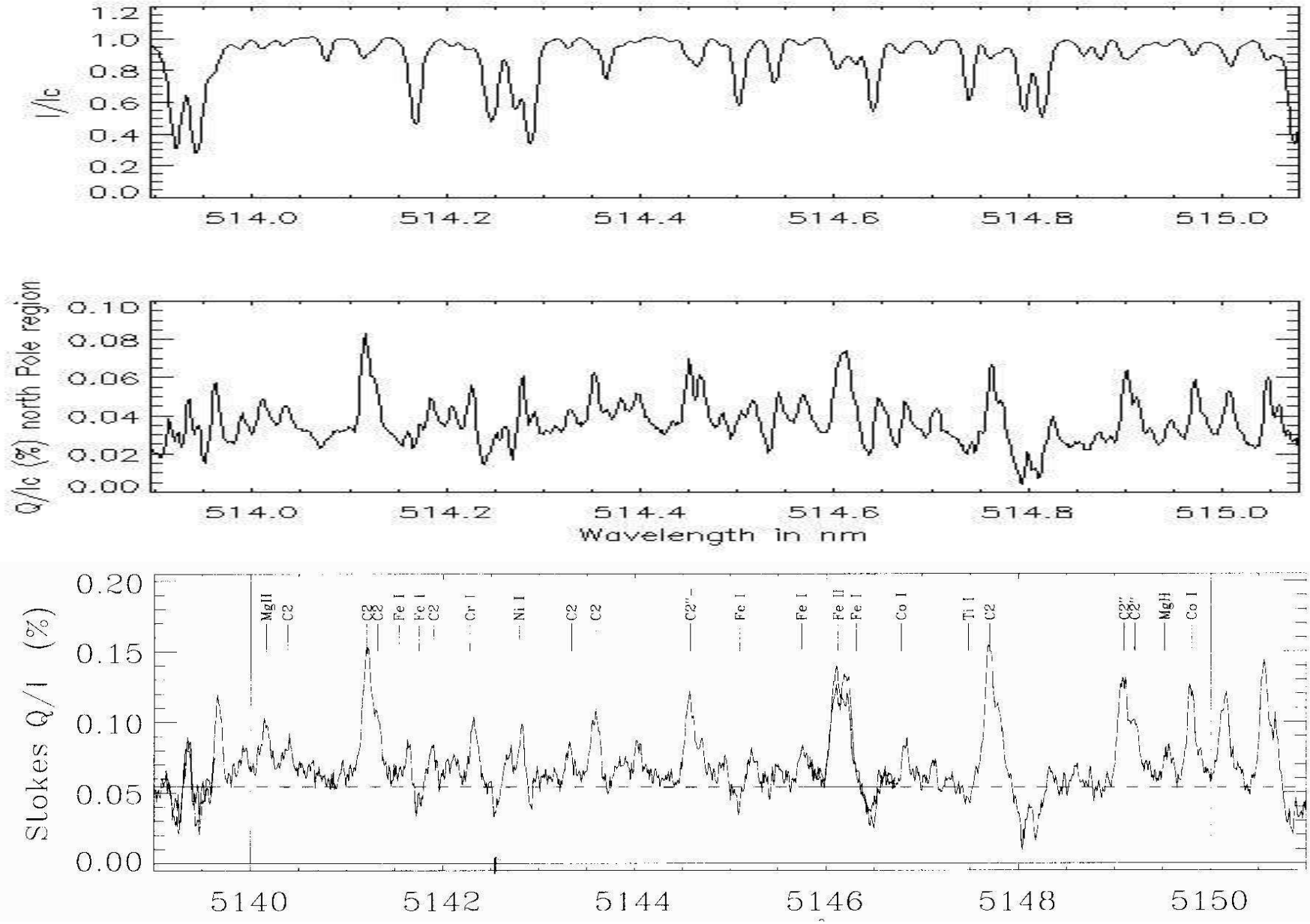

Conclusion

Those Pic du Midi LJR first molecular lines observation confirm the capability of this telescope of performing weak polarization measurements and the rich diagnostic potential of the 513 to 515 nm region of the second solar spectrum.

Trujillo Bueno et al. (Nature vol 430, 2004) predict a temperature structure implying C_2 abundances strong variations at the scale of the granulation. LJR, thanks to its excellent image quality, is a place for observing C_2 lines at this high spatial scale.